

THE HAEMATOZOA OF AUSTRALIAN FISH, No. I.

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IN former papers we have already made known some of the results obtained by us while studying the haematozoa of certain groups of our Australian fauna, namely the Amphibia,¹ Reptilia,² and Birds.³ In this note we have dealt with some trypanosomes found in certain fresh-water fish, and have given a list of our negative and positive findings as regards haematozoa. We have also made mention of a parasitic disease affecting one of our food fishes, though the parasite, a myxosporidian, is not a haematozoon.

TRYPANOSOMA ANGUILLICOLA n. sp. from the Long-finned Eel, *Anguilla reinhardtii*, Steind, and the Marbled Eel, *A. mauritana*, Bennett. (Figs. 1-6.)

To Dr. T. L. Bancroft we are indebted for the first specimens of this trypanosome which occurs in the blood of the above fresh-water eels. Of the infected hosts belonging to the former species, one was captured in January, 1910, and two in May, 1910, very few of the parasites being found in films from the first, though they were fairly numer-

¹ Cleland and Johnston, "The Haematozoa of Australian Batrachians, No. 1, this Journal, XLIV, 1910, p. 252." We omitted to mention in this paper that Dr. T. L. Bancroft exhibited a Trypanosome in the blood of a frog *Hyla nasuta*, before the Royal Society of Queensland in November 1890 (Proc. Roy. Soc. Queensland, VIII, 1890-91, p. xiii). This appears to be the earliest reference to the presence of haematozoa in Australian batrachians.

² Johnston and Cleland, "The Haematozoa of Australian Reptilia," No. 1, Proc. Linn. Soc., N.S.W., xxxv, 1910, p. 677-685.

³ Cleland and Johnston, "The Haematozoa of Australian Birds," No. 1, Journ. Proc. Roy. Soc. South Australia, 1910 p. 100-114.

ous in the other two. We have found a single example of a trypanosome belonging to the same species in one out of four specimens of *A. reinhardtii*, caught in Prospect Reservoir, near Sydney, in April, 1910. Recently (September, 1910) we have received from Dr. Bancroft, films from another eel, *A. mauritana*, Bennett, from the Burnett River, Queensland, in which the same species of parasite has been met with.

All the specimens examined resembled each other closely. The body was long and narrow, gradually attenuated towards each end. The trophonucleus was seen as a faintly staining structure (using Giemsa) lying in front of the middle of the body, while the deeply staining kinetonucleus was close to the posterior end. The protoplasm stained a deep blue, but appeared to be devoid of granules. The undulating membrane was very distinct but narrow, being about as broad as the body, and was thrown into numerous more or less regular folds. The short flagellum was scarcely recognisable.

The following are the measurements of the parasite:—total length including flagellum about 38μ , (from 35.5μ to 40μ); flagellum 3.7 to 7μ ; distance from posterior end to kinetonucleus 1.5μ ; from latter to nucleus 16 to 28μ ; maximum breadth including undulating membrane, 2.5μ ; breadth of undulating membrane, 1.2 to 1.6μ .

This species differs from *T. granulorum*, Lav. & Mesnil., of the European eel *Anguilla vulgaris* in the absence of the large distinctive granules. We propose for it the name *T. anguillicola*.

TRYPANOSOMA BANCROFTI, n.sp., from the blood of the Fresh-water Catfish, *Copidoglanis tandanus*, Mitchell. (Figs. 7–17).

To Dr. T. L. Bancroft of Queensland we are indebted for the privilege of examining and describing this new species

of trypanosome from the freshwater Catfish *Copidoglanis tandanus*, of Queensland rivers. The first specimens Dr. Bancroft obtained are shown in a slide he has forwarded to us, labelled and dated as follows:—"Trypanosome in blood of the Freshwater Catfish, discovered 17/12/'05." This slide shows the very narrow forms with very short flagella to be shortly described, and also several broader forms with basophile granules. In May 1910, we first received from Dr. Bancroft a series of blood-slides from ten of these fish recently taken at Kilroy, Queensland. An examination of these revealed the presence of trypanosomes in only one, but in this one which we have taken as our type slide, the parasites were moderately numerous and of diverse forms. Since then, a further blood slide, dated 27/5/'10, has been received from Dr. Bancroft, in which a single trypanosome was found which, though it differs materially from the specimens we have examined from the other two infected fish, we believe to be a form of the same species—a species apparently characterised by considerable pleomorphism. An examination of the type slide discloses the following variations of the parasite:—

(a) Very narrow (under 3 to under 2μ), comparatively short (27 to 31μ) forms. These show a well-marked kinetonucleus about 1μ from the pointed posterior end; a well-marked trophonucleus 8 to 12.5μ in front of this: and the body passing into the flagellum about 9μ still further forward. The flagellum in some specimens is about 11μ long, in others, apparently only about 4μ in length; while in quite a number of examples very little, if any, of this structure was discernible. We are inclined to think that in these specimens a short flagellum was rendered not visible by injury during, or defects in, preservation. In one specimen some blue granular masses were irregularly distributed in the protoplasm.

(b) One very broad specimen was discovered. Its greatest breadth was over 7μ and its length about 50μ . The well-marked kintonucleus was 1.78μ from the beaked posterior end; the trophonucleus, a faint purple surrounded by a paler area, was about 3.5μ in breadth and was nearly 12.5μ from the kintonucleus; the anterior end narrowed rapidly to end in the flagellum nearly 11μ in front of the trophonucleus; the flagellum itself was nearly 21.5μ long. Three small vacuole-like structures were visible in the anterior portion of the parasite and the whole of the protoplasm was peppered with large deep blue granules, resembling in appearance those of the "mast cells" of human blood.

(c) An intermediate form between these two types showing a number of scattered basophile granules, was seen. Its total length was nearly 34μ , and greatest breadth 3.5μ .

In the blood from a Catfish dated 27/5/'10, the parasite presented a different appearance. Granules were not apparent, but the protoplasm was very deeply stained blue in a somewhat streaky fashion, and the nucleus thereby partly obscured. The kintonucleus was marked, but a free flagellum as such was not recognisable. A lighter area, now on one side, now on the other of the deeper-stained protoplasm represented the undulating membrane, and this part of the flagellum could just be discerned following the membrane and crossing the body. At its broadest, the membrane was under 2μ in width. This is the only specimen in which we have been able to recognise this structure. This particular parasite was nearly 53.5μ long and had a diameter of 4.45μ .

The species under review seems to approach most closely to *T. granulosum*, Laveran and Mesnil, from the eel (*Anguilla vulgaris*). Like this parasite, our species varies much in size, and certain specimens are characterised by

large and prominent deeply stained granules. The flagellum, however, seems to be distinctly shorter and the undulating membrane less prominent, while in some the anterior extremity narrows rapidly. Laveran and Mesnil in their species do not seem to have met with the very broad form that we have found.

Of the trypanosomes of other freshwater fish, *T. danielewski*, Lav. and Mesnil, of the carp (*Cyprinus carpio*) contains chromatic granules. Its undulating membrane is broad, however, and the flagellum long. *T. remaki*, Lav. and Mesnil, of the pike has no granules.

We propose the name *T. bancrofti* for the species under review, in honour of Dr. T. L. Bancroft.

“MILKY BARRACOOKA,” a disease of the Body Tissues due to a Myxosporidian Parasite *Chloromyxum* sp.

The Barracooka (*Thyrsites atun*, Euph.) in Australian waters is subject to a peculiar disease, characterised by a softening and milkiness of the muscular tissue of the body. This fish appears off the West Australian coast in July and August, and, amongst those caught and exposed for sale in the shops, the “milky” ones can be easily distinguished by their more diffluent appearance and softened feel. The disease is also met with in the Eastern States (New South Wales, Victoria, and Tasmania). On incising an infected fish, the muscular tissue is found to be soft and diffluent and almost of the consistency of thick condensed milk. When portions are seized by forceps and held up, thick drops fall from the instrument, still more accentuating this resemblance. The tissue is whitish or slightly blood-tinted and pulls off the bones leaving them bare. An examination of stained films from the softened muscular tissue showed the presence of peculiar bodies arranged somewhat in the form of a Maltese cross. Specimens were forwarded to Prof. E. A. Minchin, F.R.S., in whose hands

they now are awaiting description. In a letter to one of us, he has identified the parasite as a Myxosporidian possessing four polar capsules, and hence belonging to the genus *Chloromyxum*.

The following is a list of species of fish which have been unsuccessfully examined by us for the presence of haematozoa. The date and number of specimens are given. The number of the species in Waite's¹ Synopsis is prefixed to each. Unless otherwise mentioned the fish were taken from Sydney Harbour or the neighbouring waters:—

ELASMOBRANCHII.

6. *Catulus analis*, Ogilby (Spotted Cat Shark), 8/09, (1 spec.)
 10. *Orectolobus barbatus*, Gmel. (Wobbegong Shark) Port Stephens, 1907, (1).
 11. *Mustelus antarcticus*, Gunth. (Gummy Shark) South Australia, 1910, (1).
 14. *Prionace glauca*, Müll. and Henle (Blue Shark) South Australia, 1910, (1).
 16. *Carcharias gangeticus*, Müll. and Henle (Sea Shark), Queensland, 1910, (1).
 — *Sphyrna tudes*, Ouv. (Hammerhead Shark), Queensland, 1910, (1).
 31. *Trygonorrhina fasciata*, Müll. and Henle (Fiddler), Port Stephens, 1907, (1).
 38. *Trygonoptera testacea*, Müll. and Henle (Common Sting-ray) Jervis Bay, 7/10, (1).
 41. *Dasyatis Khulii*, Müll. and Henle (Blue-spotted Sting-ray), Queensland, 1910, (1).
 45. *Myliobatis australis*, Macleay (Eagle Ray), 3/10, (1).
 — *Chiloscyllium* sp., Queensland, 1910, (1).

TELEOSTII.

66. *Cnidoglanis megastomus*, Rich. (Estuary Cat-fish), Hawkesbury, 4/10, (1).

¹ E. R. Waite, "A Synopsis of the Fishes of New South Wales," Memoirs of the N.S.W. Naturalists' Club, No. 2, 1904.

120. *Hippocampus novae-hollandiae*, Steind. (Common Sea-horse),
6/09, (4).
- *Lutianus sebae*, C. and V. (King Schnapper), Queensland,
1910. (1)
- *Lutianus amabilis*, De Vis (Hussar Fish), Queensland, 1910,
(1).
212. *Glaucosoma scapulare*, Ramsay (Epaulette), Queensland,
1910, (1).
237. *Scieana antarctica*, Cast. (Jewfish), Queensland, 1910, (1).
- *Scolopsis vosmaeri*, (Big-eyed Bream), Queensland, 1910, (1).
262. *Pagrosomus auratus*, Forster (Schnapper), Port Stephens,
1907, (1).
266. *Lethrinus chrysostomus*, Rich. (Emperor Fish), Queensland,
1910, (1).
269. *Upeneus porosus*, Cuv. and Val. (Common Red Mullet),
/09, (2).
270. *Upeneus signatus*, Gunth. (Spotted Red Mullet), 6/09, (1).
305. *Achoerodus gouldii*, Rich. (Blue Groper), Queensland, 1910,
(1).
321. *Ophthalmolepis lineolatus*, Cuv. and Val. (Rainbow Fish),
Port Stephens, 1907, (1).
325. *Odax balteatus*, Cuv. and Val. (Little Rock Whiting), 6/09,
(1).
330. *Seriola lalandi*, Cuv. and Val. (King Fish), Queensland,
1910, (1).
342. *Scomber colias*, Gmel. (Mackerel), 5/09, (1).
348. *Thysites atun*, Euphr. (Barracoota), 7/09, (1).
390. *Echeneis naucrates*, Linn. (Sucking Fish), Queensland, 1910,
(1).
395. *Scorpaena cruenta*, Rich. (Spotted Red Rock-cod), Queens-
land, 1910, (1).
396. *Scorpaena cardinalis*, Rich. (Red Rock-cod), Port Stephens,
1907, (1).
468. *Batrachoides dubius*, Shaw (Frog Fish), 6/09, (2).
- *Balistes capistratus*, Shaw (File Fish), Queensland, 1910, (1).

482. *Monacanthus megalourus*, Rich. (Big-tailed Leather-jacket), 6/09, (4).
 — *Monacanthus* sp.¹ (Leather-jacket), Port Stephens, 1907, (2).
 495. *Pseudomonacanthus maculosus*, Rich. (Spotted Leather-jacket), 6/09, (6).
 502. *Brachaluteres trossulus*, Rich. (Pigmy Leather-jacket), 6/09, (1).
 524. *Dicotylichthys punctulatus*, Kaup. (Porcupine Fish) 7/09, (1).
 — *Genypterus blacodes*, (Australian Rock-ling), 7/09, (1).
 — *Xiphias gladius*, Linn. (Sword-fish), 6/10, (1).
 — *Plectopomus maculatus*, (Leopard Fish), Queensland, 1910, (1).
 — *Choirodon venustus*, (Blue Parrot-fish), Queensland, 1910, (1).
 — *Plectorhynchus punctatus*, (Sweet-lip), Queensland, 1910, (1).

We are not aware of any records of the occurrence of haematozoa in Australian fish, but in the following three species we have seen blood parasites :—

71. *Anguilla reinhardtii*, Steind.² (Long-finned Eel), May, 1910, Queensland ; trypanosomes in three examined. Prospect Reservoir, N.S.W., April, 1910 ; trypanosomes in one out of four examined.
 — *Anguilla mauritana*, Bennett (Marbled Eel), September, 1910, Burnett River, Queensland, in one examined.
 64. *Copidoglanis tandanus*, Mitchell (Fresh-water Cat-fish), Queensland, May, 1910 ; trypanosomes in two out of eleven examined.

From the above it will be seen that seventy-seven fish belonging to forty-seven species were examined. Only seven individuals belonging to three species (all from fresh-water) were found to be infected with haematozoa. The percentage of infected species was thus about six, whilst

¹ In one of these specimens, peculiar "ring-bodies" were detected in the erythrocytes. Johnston and Cleland, Proc. Linn. Soc. N.S. Wales, xxxiv, 1909, p. 508-9.

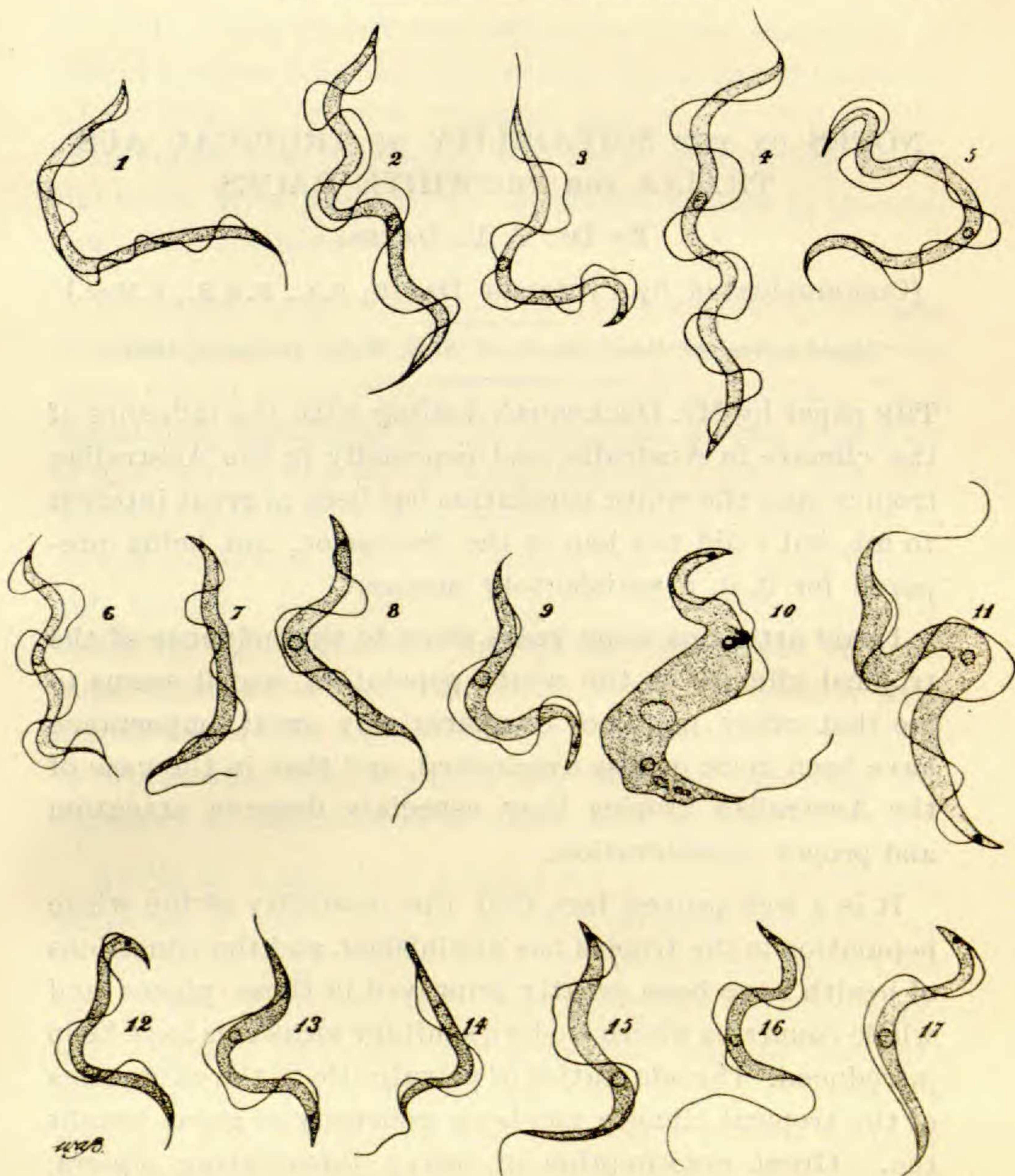
² This species is listed in Waite as *A. bengalensis*, Gray.

infected individuals amounted to about 9% of the total number searched. The absence of haematozoa in the marine fish examined is noteworthy. Neuman¹ has recently published an important paper in which he gives an account of the parasites found by him. He examined six hundred and fourteen marine fish belonging to sixty species (p. 4-5), haematozoa being detected in one hundred and twenty individuals in thirteen different species. He also searched films from fourteen specimens of one species of fresh-water fish with negative results. The number of infected individuals (from marine and fresh-water species) was thus one hundred and twenty out of a total of six hundred and twenty-eight examined, the percentage being nearly twenty. He found parasites in fish belonging to thirteen out of sixty-one species under observation, the percentage being nearly twenty-five. His results are thus very different to ours.

The type slides of *Trypanosoma anguillicola* (from *Anguilla reinhardtii*) and *T. bancrofti* (from *Copidoglanis tandanus*) have been deposited in the Australian Museum, Sydney.

Our thanks are especially due to Dr. T. L. Bancroft who found these trypanosomes in Queensland fish and kindly handed over the films to us for description; to Mr. A. R. MacCulloch of the Australian Museum, Sydney, who has been good enough to identify our specimens for us: to the Director, Dr. F. Tidswell; and Dr. E. S. Stokes, for forwarding material, and Mr. F. Hallmann for supplying us, by permission of Mr. H. Dannevig, with a large number of films taken by him from fish captured off Queensland by the Federal Trawler S.S. "Endeavour," and identified by Mr. J. Douglas Ogilby.

¹ Neumann, R. O., "Studien über protozoische Parasiten im Blut von Meeresfischen," Zeitschr. f. Hyg. Infektskr., LXIV, 1909, p. 1 - 112



Figs. 1-4 *Trypanosoma anguillicola* from *Anguilla reinhardtii*, (Queensland.)

Fig. 5 *Trypanosoma anguillicola* from *Anguilla mauritana* (Queensld.)

Fig. 6 *Trypanosoma anguillicola* from *Anguilla reinhardtii* (Prospect, N.S.W.). This figure has been drawn on a smaller scale than the others.

Figs. 7-17 *Trypanosoma bancrofti* from *Copidoglanis tandanus*. The specimen figured in fig. 10 was probably damaged.